

Teracolus vi. The specimen was almost the first female of the species which I obtained. The individuals of this butterfly roosted regularly on the stalks of the plant in question, their under-sides being of about the same tint as the dried-up leaves and stems.

“‘*Fatehpore Sikri, near Agra, May 1877.*—Spiders lay in wait for the Pierine *Belenois mesentina*, on the flowers of a caper (*Cupparis aphylla*). On this occasion the spiders took a very heavy toll of the butterflies.’”*

[Mr. C. J. M. Gordon has sent to the Hope Department a male specimen of *Acras bonasia*, which he found on January 8, 1902, at Old Calabar, in the grasp of a flower-haunting spider (*Thomisus*, sp.). The falcies of the arachnid were fixed in the butterfly's thorax, and the insect was nearly dead.—E. B. P.]

6. THE ATTACKS OF PREDACEOUS INSECTS OTHER THAN MANTIDE UPON CONSPICUOUS SPECIALLY-DEFENDED LEPIDOPTERA, ETC. (E. B. P.)

H. W. Bates, in the historic paper which contained the first suggestion of the theory of Protective Mimicry (Trans. Linn. Soc., vol. xxiii, 1862, p. 495), states concerning the attacks of predaceous insects: “I never saw the flocks of slow-flying *Heliconidæ* [in the writings of Bates and Belt upon Mimicry, the *Heliconidæ* always include the *Ithomiinæ* or *Neotropinæ*, then called the *Danaoid Heliconidæ*] in the woods persecuted by birds or Dragon-flies, to which they would have been an easy prey; nor, when at rest on leaves, did they appear to be molested by Lizards or the predaceous Flies of the family *Asilidæ*, which were very often seen pouncing on Butterflies of other families” (p. 510).

There is, however, good reason for believing that such attacks are not rarely made, and that predaceous insects are important enemies of aposematic butterflies.

In the following three sub-sections of this paper I have brought together some slight evidence in support of this conclusion. Far more requires to be done, and it is hoped that the attention which is here directed to the inquiry

* Shortly after I had made the observation I came across a reference to this habit of the spiders at the very same place, but I cannot now recall the name of the publication.—J. W. Y.

may bring the subject to the notice of naturalists, especially in the parts of the world where the struggle for existence is keenest.

A. Predaceous Hymenoptera and Neuroptera.

The Neuroptera are included here and not under a separate heading because I have as yet only received a single record, and that one in association with an observation on predaceous Hymenoptera. Accurate observations on Odonata and *Mantispidæ* are greatly needed, as well as on the predaceous Hemiptera. Large *Tenthredinidæ* should also be observed, for I have seen them devouring insects. *Locustidæ* furthermore are considerable and indiscriminate enemies of their class. I have seen them eating Acridians, and there is a specimen of one in the Hope Department together with its victim, a moth.

The late Thomas Belt long ago recorded the capture of Nicaraguan "*Heliconidæ*" by a yellow and black banded wasp for the purpose of storing its nest: "Whenever one of these came about, they would rise fluttering in the air, where they were safe, as I never saw the wasp attack them on the wing. It would hawk round the groups of shrubs, trying to pounce on one unawares; but their natural dread of this foe made it rather difficult to do so. When it did catch one, it would quietly bite off its wings, roll it up into a ball, and fly off with it" ("Naturalist in Nicaragua," Lond., 1888, p. 109). The following observation of Mr. Marshall's upon the chief unpalatable butterfly of the Old World compares in an interesting manner with the foregoing:—

"*Tugela River, junction with Blaauwkrantz River, Dec. 14, 1896.*—I have observed two enemies of *Limnas chrysippus* lately: one is a large wasp which I saw carrying off the larvæ, and the other was a very large red dragonfly which was devouring an imago." It is quite likely that the Odonata may not uncommonly attack such conspicuous butterflies, but this is the only record I have as yet received.

Experiments and observations on ants suggest an almost boundless field of inquiry. The following interesting observation made by my friend Mr. C. J. M. Gordon, M.A., of Balliol College, clearly proves that certain ants neglect

specimens of *Acraeas* when they can get other butterflies. Mr. Gordon writes of two *Acraeas* captured Jan. 13, 1902, at Old Calabar: "So distasteful do these butterflies seem to be that even the ants will not eat them. These specimens are the only survivors of a set of about twenty. The ants got in and ate all the rest, leaving these, as you see, untouched." It is interesting to note that the species were very different, being *Acraea admathu* and *A. neobule*. The specimens are in the Hope Department, Oxford.

B. *Predaceous Coleoptera.*

A great deal of work remains to be done with the predaceous Coleoptera. So far as I am aware Professor F. Plateau is the only naturalist who has made any important use of them, but there is reason to infer from his experiments that they too are important enemies to aposematic insects. One section of his paper (Mém. de la Soc. Zool. de France, tome vii, p. 375, § 9) is devoted to experiments in which *Abraxa* larvæ were offered to *Carabus auratus*, *Dytiscus marginatus* [*marginalis*], and *D. dimidiatus*. Two of the *Carabi* in confinement were starved for about eleven hours, and then given one full-grown and two smaller larvæ of *Abraxa*. One beetle fed upon the large larva continuously for about an hour, only leaving the thoracic region. The other *Carabus*, of which one antenna was mutilated, after half-an-hour attacked one of the smaller caterpillars and then abandoned it. When the observer returned after a few hours both the smaller larvæ were partially eaten. Twelve hours later the beetles were perfectly well. The experiment was renewed with two fresh *Carabi* starved for eighteen hours. The beetles began to devour the larger of two larvæ given to them, and even fought over it: in an hour only the torn and empty skin remained. By the next morning the second larva had been devoured, and the beetles were quite healthy. Three imagines of *Abraxa* were then offered to two freshly-caught *Carabi*. After three hours one moth was nearly devoured, after about six hours the second, and by the following morning the third. There only remained some fragments of the wings. The beetles were as active as ever. Several larvæ were then thrown into an aquarium containing the two above-mentioned species of *Dytiscus*. The latter at once attacked them, fighting over their prey, which seemed to be entirely consumed.

These results are tolerably decisive; but it would have been more satisfactory if the experiments had been continued for a much longer period and controlled by others in which different forms of food were employed. In this way a convincing test of the wholesome qualities of the larvæ would have been supplied. In other experiments, again, it would have been desirable to offer a wide choice, and ascertain if there are any marked preferences.

Mr. G. A. K. Marshall has also observed one of the *Histeridæ*, *Hister caffer* (Erichs.), eating a far larger beetle than itself, the Scarabæid *Onitis alexis*. He has also observed the same beetle devouring *Aphodii*.

On July 19, 1898, I observed a large Elaterid (*Corymbites virens* ♀) eating the larvæ of *Vanessa urticæ* on a nettle beside the mountain road (6000 feet) from Leukerbad to the Gemmi Pass, Valais. The specimens are now in the Hope Department.

C. Predaceous Diptera.

It is convenient to bring together the numerous records of the attacks of *Asilidæ* upon insects into a tabular statement. In its preparation I have received the kindest help and co-operation from Colonel Yerbury, Colonel Bingham, Mr. G. A. K. Marshall, Mr. A. H. Hamm, and Dr. Chapman.

* *Specimen in Hope Department, Oxford. + Specimen in Collection of British Museum (Natural History).*

OBSERVER.	LOCALITY.	DATE.	SPECIES OF ASILID.	NAME OF PREV.
J. W. Verbury.	Trinkomali, Foul Point.	Oct. 26, 1890.	<i>Maira</i> , sp.? ♀.†	Syrphid, Eumerus, sp.†
J. W. Verbury.	Malagan, Trinkomali.	Nov. 30, 1890.	? Sp. and gen. ♀.†	Muscid.†
J. W. Verbury (Zoologist, 1900, p. 559).	Trinkomali.	Nov. 1890.	<i>Microstylum apicale</i> (Wied.).	Cicadon, Tibicen nubifera.
J. W. Verbury.	Nilavelli, Trinkomali.	Nov. 16, 1890.	<i>Microstylum apicale</i> ♀.†	Acridian.†
J. W. Verbury (Proc. Linn. Soc., v. 24, Zool., p. 551).	Trinkomali.	1890—91.	<i>Promachus maculatus</i> (Fabr.).	Dragon-fly, Brachythemis (Fabr.).†
J. W. Verbury.	Trinkomali.	July 18, 1891.	<i>Scleropogon ambryon</i> (Walk.) ♀.†	Dipteron, Scleropogon ambryon ♀.†
J. W. Verbury.	Perivipancheram, Trinkomali.	April 21, 1891.	? <i>Philadicus</i> , sp. ♀.	Dipteron, Large Tachinid, ? gen. and sp.
J. W. Verbury.	Trinkomali.	June 25, 1891.	<i>Scleropogon ambryon</i> ♂.†	Butterfly, Tirumala limniace.†
J. W. Verbury.	Perriya Kulam, Trinkomali.	Oct. 18, 1891.	<i>Scleropogon ambryon</i> ♀.†	Another Asilid, ? gen. and sp.†
J. W. Verbury.	Lyndhurst, New Forest.	May 27, 1894.	<i>Dioctria alaudina</i> (L.) ♀.†	Ichneumon.†

* Specimen in Hope Department, Oxford. † Specimen in Collection of British Museum (Natural History).

OBSERVER.	LOCALITY.	DATE.	SPECIES OF ASILID.	NAME OF PREY.
J. W. Yerbury.	Gravesend.	June 4, 1893.	<i>Dioctria atricapilla</i> (Mg.) ♀. †	Ichneumon. †
J. W. Yerbury (Trans. Ent. Soc. Lond. 1899, p. 93).	Lahej, Aden.	March 6, 1895.	<i>Philodicus gracilis</i> (v.d.W.) ♂. *	Butterfly, Zizera gaika.*
J. W. Yerbury (Trans. Ent. Soc. Lond. 1899, p. 93).	Huswah, Aden.	April 14, 1895.	<i>Apoclea femoralis</i> (Wied.) ♀. *	Butterfly, Synchloe glauconome.
J. W. Yerbury.	Ledbury.	June 4, 1895.	<i>Dioctria rufipes</i> (Deg.) ♀. †	Ichneumon. †
J. W. Yerbury.	Lyndhurst.	June 25, 1894.	<i>Neoitamus cyanurus</i> (Loew) ♀. †	Coleopteron, ? gen. and sp. †
J. W. Yerbury.	Brockenhurst.	June 14, 1894.	<i>Machinus atricapillus</i> (Fallen) ♀. †	Dipteron, Chrysops cæcilius (L). †
Guy A. K. Marshall.	Malvern, Natal.	March 28, 1897.	? Gen. and sp.	Butterfly, Precis elgiva.
Guy A. K. Marshall.	Untali, Mashonaland, 3700 ft.	Dec. 1900.	? Gen. and sp.	Butterfly, Acreea caldarena (Hew.).
Guy A. K. Marshall.	Untali, Mashonaland, 3700 ft.	Dec. 29, 1900.	<i>Alecinus ? stenurus</i> (Loew) ♀. *	Butterfly, Lampides beetica.*
Guy A. K. Marshall.	Salisbury, Mashonaland, 5000 ft.	May 5, 1901.	<i>Lophonotus ? scillus</i> (Fabr.) ♂. 38.0 m.m. across wings.*	Dragon-fly, Trithemis arteriosa (Burm.). 47.0 m.m. across wings.*

* *Specimen in Hope Department, Oxford.* + *Specimen in Collection of British Museum (Natural History).*

OBSERVER.	LOCALITY.	DATE.	SPECIES OF ASILID.	NAME OF PREY.
Guy A. K. Marshall.	Salisbury, Mashonaland, 5000 ft.	Oct. 6, 1901.	<i>Promachus</i> , sp., perhaps <i>vagator</i> (Wied.) ♀.*	Dragon-fly, <i>Trithemis</i> , sp., probably im- mature <i>T. dorsalis</i> (Ramb.).*
Guy A. K. Marshall.	Chirinda Forest, Gazaland, 4500 ft.	Dec. 12, 1901.	<i>Proconistes</i> , sp., probably <i>praveps</i> (Walk.) ♀.*	Aculeate, <i>Haliectus</i> , sp., close to <i>torridus</i> (Sm.), but smaller.*
Guy A. K. Marshall.	Salisbury. Mashonaland.	Jan. 26, 1902.	<i>Promachus equalis</i> (Loew) ♀.*	Beetle, <i>Heteromera</i> , <i>Lagria</i> , sp.*
C. T. Bingham.	Domdami Valley, Martaban, U. Tenasserim.	Aug. 27, 1893.	<i>Promachus</i> , sp.? near <i>flavi- barbis</i> (Macq.) ♀. 35 m.m. across wings.†	Dragon-fly, <i>Rhyothemis phyllis</i> (Salz.). 78 m.m. across wings.†
C. T. Bingham.	Ataran Valley, L. Tenasserim.	April 1898.	<i>Damalina</i> ? sp. ♀.*	Aculeate, <i>Melipona apicalis</i> (Sm.).*
W. R. Ogilvie-Grant (Zoologist, 1900, p. 559).	Socotra.		<i>Promachus solutor</i> (Ric.) M.S. ♂.†	Small Cicada ? sp.†
E. B. Poulton.	Near Brieg, Valais, Switzer- land, 2450 ft.	July 24, 1898.	<i>Dasypogon diadema</i> (Fabr.) ♂.*	Dipteron, <i>Sarcophaga</i> , sp.*
E. B. Poulton.	Montserrat, near Barcelona.	July 15, 1901.	<i>Eutolmus</i> ? <i>apicalis</i> (Loew) ♂ ♀ in cop.; the lower insect, pro- bably ♀, with prey.*	Dipteron; Anthomyid, <i>Mydaea</i> , sp., probably either <i>urbana</i> or <i>lagana</i> .*

* Specimen in Hope Department, Oxford. † Specimen in Collection of British Museum (Natural History).

OBSERVER.	LOCALITY.	DATE.	SPECIES OF ASILID.	NAME OF PREY.
E. B. Poulton.	Cerbère, Eastern Pyrenees.	July 17, 1901.	<i>Epitriptus arthriticus</i> (Zeller) ♀.*	Acridian, <i>Podisma frigida</i> (Boh.) ♂.*
E. B. Poulton.	Cerbère, Eastern Pyrenees.	July 17, 1901.	<i>Epitriptus arthriticus</i> (Zeller) ♀.*	Acridian, <i>Podisma frigida</i> (Boh.) ♂.*
G. C. Nurse.	Disa, Bombay Presidency.	June 1897.	<i>Neoitamus</i> , sp., perhaps <i>longistylus</i> (Wied.) ♀.*	"Beetle twice its weight."
G. C. Nurse.	Disa, Bombay Presidency.	Oct., 1899.	<i>Neoitamus</i> , sp., perhaps <i>griseus</i> (Wied.) ♀.*	Butterfly, <i>Catochrysops contracta</i> .
A. H. Hamm.	Port Bon, Eastern Pyrenees.	June 24, 1901.	<i>Dasygogon diadema</i> (Fabr.) ♀.*	Aculeate, <i>Polistes gallica</i> .*
J. C. Bowring.	Hong Kong.	Presented to B. M. 1861.	<i>Microstylum dux</i> (Wied.) ♀.†	Beetle, <i>Protetia mandarina</i> , "its beak through the elytra of the <i>Cetonia</i> ."
T. B. Fry.	Probably Poona.	About 1888.	<i>Laxeocera</i> sp. ♀.*	Aculeate, <i>Apis florea</i> ♀ (Fabr.).*
T. A. Chapman (Ent. Record, 1902, p. 72).	Tragacete, Albaracin Mts., Spain.	July 18—26, 1901.	<i>Laphria gibbosa</i> (Linn.) ♂ and ♀ in cop.; the lower insect, the ♀, with prey.*	Beetle, <i>Buprestis (Ancylocheira) flavomaculata</i> , proboscis through cephalothoracic articulation.* A different beetle also seen transfixed by the same species.

Colonel Bingham has sent me the following notes of his observations on *Asilidæ*: "With regard to flies of the family *Asilidæ* and spiders attacking butterflies, I find only a very few scattered notices of cases which I had seen, but no details, I am sorry to say. So far as I can remember I have seen these flies once or twice actually capture butterflies, and in one instance I find it noted in my diary that I found an *Asilus* with a *Junonia hierta* which was still slightly quivering its wings. I have seen the flies not once, but often swoop at butterflies, dragonflies, and bees. I cannot, however, find any particular note of that case of the *Asilus* with a dragon-fly the specimens of which are in the British Museum. What note I made was written on the paper envelope in which the specimens had been put away. With regard to the *Asilus* which I found attacking the dammar bees (*Melipona*), I find that I have noted that they, the flies, persistently hover round the nest-mouth of the dammar bees, and catch the latter on the wing as they issue from the nest. The flies, so far as I have noticed, never eat their prey on the wing, but retire to a bush holding their prey with their long hairy legs."

A study of the table at once shows that the *Asilidæ* are most indiscriminate in their attacks. The stings of the Aculeates, the distasteful qualities of *Danaidæ* and *Acræidæ* and of the odoriferous *Lagriæ*, the hard chitinous covering of Coleoptera, the aggressive powers of Odonata, are alike insufficient protection against these active and voracious flies. The only tendency towards specialization in the direction of any particular group of prey appears to be manifested in the preference of the slender Asilids of the genus *Dioctria* for Ichneumonids.* The far greater frequency with which the female Asilid has been observed with prey is sufficiently accounted for by the larger size of this sex and the more important part borne by it in reproduction.

Looking at the table as a whole, and the large proportion of attacks made upon specially-defended insects, the

* Since this sentence was written I have captured (July 1902) many specimens of *Dasygaster diadema* with prey at La Granja, Sierra Guadarrama, Spain. The great majority of these were sucking Aculeates, especially the hive-bee. Another species of Asilid, on Peñalara, also exhibited an apparent preference for Coleoptera.—E. B. P.

conclusion is suggested that Bates was mistaken in supposing that Asilid flies play no part as the enemies of *Heliconinæ* and *Ithomiinæ*.

7. LEPIDOPTERA WITH WARNING COLOURS SPECIALLY
LIABLE TO THE ATTACKS OF PARASITIC INSECTS.
(G. A. K. M.)

[The late Erich Haase in his work on mimicry (English translation "Researches on Mimicry," etc., Pt. II, Stuttgart, 1896) continually made the assumption that the immunity of *Danainæ*, *Acrwinæ*, and other specially-protected groups is absolute, and extends to the attacks of parasitic Hymenoptera and Diptera as well as to those of insect-eating vertebrates. A little reflection upon the rate of multiplication of animals, and especially of insects, makes it clear that any such absolute immunity is an impossibility. A high degree of protection from the attacks of the generality of insect-eating animals will always be found to be compensated by the attacks of special enemies, and probably very largely by that of insect parasites. I brought forward this argument in 1890 ("Colours of Animals," London, p. 181); and Haase, without attempting to meet it, made the crude assumptions which will now be dismissed, once and for all, by the numerous observations recorded below.—E. B. P.]

Estcourt, Oct. 15, 1896.—We brought seventy-five larvæ of *Acræa anacreon* home with us from Ulundi to Estcourt, and no less than twenty of them were killed by a Dipterous parasite, so that, although it may be protected in the imago stage, the percentage of larval deaths must be very high.

Malvern, Feb. 21, 1897.—I certainly cannot understand Haase's attitude with regard to protection from parasites. There are such patent examples to disprove it among European "whites." Out of eight pupæ of *Acræa horta* that I bred this season no less than five were killed by a Dipterous parasite.

[I have also received from Mr. Marshall two cocoons and two imagines of an ichneumon bred from *Acræa cabira* at Malvern. They bear the date April 1897.—E. B. P.]

Umkomaas Mouth, Natal; Sept. 3, 1897.—I think it is highly probable that *Byblia ilithyia* will prove to be distasteful as you suggest; but so far as my experience goes